# Atypical presentations of ectopic pancreatic tissue

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Abstract: Background Ectopic pancreatic tissue (EPT) in a Meckel diverticulum is a well-known anomaly. Other locations are rare, especially in pediatric patients. We report on three children with incidental findings of EPT and reviewed the literature. Patients and methods Three children with incidental findings of EPT treated in our department, and 62 patients found in the literature were analyzed. The literature search was performed excluding EPT in Meckel's diverticulum and in tumors, i.e. teratomas. Results Two of our patients presented with an umbilical mass. The third patient presented with a gastric outlet obstruction due to an antral/pyloric mass. Histopathology showed EPT in all three of our patients without any signs of malignancy. In the literature, patients with EPT often appear to be asymptomatic. Symptomatic patients may present with bowel obstruction or intussusception. EPT in the umbilicus frequently seems to cause umbilical discharge. Our analysis supported the leading opinion in the literature that the upper gastrointestinal tract and especially the gastric antrum must be considered the most common location of EPT. Conclusion Although unusual in children, awareness of EPT may help to obtain the proper diagnosis faster and to plan accurate surgical therapy.

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# Atypical presentations of ectopic pancreatic tissue

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ABSTRACT

*Background:* Ectopic pancreatic tissue (EPT) in a Meckel diverticulum is a well-known anomaly. Other locations are rare, especially in pediatric patients. We report on three children with incidental findings of EPT and reviewed the literature.

*Patients and methods:* Three children with incidental findings of EPT treated in our department, and 62 patients found in the literature were analyzed. The literature search was performed excluding EPT in Meckel's diverticulum and in tumors, i.e. teratomas.

*Results:* Two of our patients presented with an umbilical mass. The third patient presented with a gastric outlet obstruction due to an antral/pyloric mass. Histopathology showed EPT in all three of our patients without any signs of malignancy.

In the literature, patients with EPT often appear to be asymptomatic. Symptomatic patients may present with bowel obstruction or intussusception. EPT in the umbilicus frequently seems to cause umbilical discharge. Our analysis supported the leading opinion in the literature that the upper gastrointestinal tract and especially the gastric antrum must be considered the most common location of EPT.

*Conclusion:* Although unusual in children, awareness of EPT may help to obtain the proper diagnosis faster and to plan accurate surgical therapy.

*Levelof evidence:* Prognosis study, Level IV.

## 1. Introduction

EPT is defined as pancreatic tissue without vascular or anatomical connection to the pancreas [1–9]. The finding of pancreatic tissue in a Meckel's diverticulum as a remnant of the omphalo-mesenteric duct is a well-known anomaly. Other locations of EPT are much rarer. The most common location is the upper gastrointestinal tract [1,5,10,11] especially along the greater curvature in the antrum, and less frequent in the jejunum, ileum, ampulla of Vater, or the gallbladder [2,9,12–14]. Of all cases with EPT, 70–90% are located within the gastrointestinal tract [15,16]. Other locations as the umbilicus, the fallopian tubes or even the mediastinum have been described [1,5,17,18]. Symptomatic cases are usually seen with EPT located in the stomach or in the duodenum [1]. There seems to be a male predominance of 3:1 [19].

More than 60% of patients with EPT are believed to be non-symptomatic [15]. It is therefore usually detected in the 4th – 6th decade of life [4,5] when it may lead to malignancies [20] or as an incidental finding during surgery or at autopsy [1,6,12]. Pediatric cases are reported rarely [21], most likely due to the paucity of symptoms, the small size of the lesions and its extremely slow growth [4].

We therefore report three cases of EPT in pediatric patients that have recently been diagnosed and treated at our department. In addition, we reviewed all published cases of EPT in pediatric patients in other sites than Meckel's diverticulum or tumors, i.e. teratoma.

## 2. Patients

### 2.1. Patient 1

A 4-month old male infant, born at term, was referred to our outpatient clinic for an umbilical granuloma that had been resistant to the pediatrician's therapy with topical application of silver nitrate. The granuloma was first observed at the age of 2 weeks and showed clear umbilical discharge. An ultra-sound excluded a connection to the intestine or the bladder, upon which the application of topical sil-

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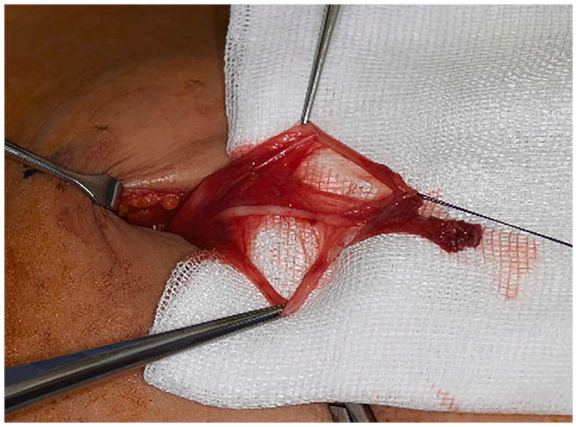

**Fig. 1.** Umbilical exploration in Patient 2.


**Fig. 2.** Ultrasound of patient 3 (S: Stomach, T: Tumor).

ver nitrate was continued. Since there was persistent discharge and ultrasound could not exclude an omphalomesenteric duct, a surgical umbilical exploration was performed. Intraoperatively, the lesion appeared to be epi-fascial without connection to the abdominal cavity. The lesion was resected and the postoperative course was uneventful.

### 2.2. Patient 2

An 8-year old boy presented to our clinic with clear umbilical discharge since birth. The boy had recently emigrated from Afghanistan and the condition had never been treated medically before. Five months prior to presenting to our clinic, he had suffered from an umbilical infection which had healed quickly after the application of betadine ointment. At examination, the umbilical skin was non-irritated and seemed to consist partly of mucosal tissue. A blunt probe revealed a tiny fistula channel of a few millimeters in depth. There was no discharge upon pressure. Ultrasonography and VCUG did neither show a connection to the intestine, nor a urachal remnant. We therefore performed an umbilical exploration, revealing fibrous tissue connected to the umbilicus, which was resected (Fig. 1). No other anatomical abnormality was found. The postoperative course was uneventful.

### 2.3. Patient 3

A 16-year old boy was transferred to our clinic with recurrent upper abdominal pain for 2 weeks and findings of an elevated CRP (83 mg/L) with a normal leucocyte count. An ultrasound showed a cystic lesion at the antral gastric wall close to the pylorus (Fig. 2). This finding was confirmed by a CT-scan (Fig. 3). An infected mesenteric cyst or a duplication cyst was considered and antibiotics (Zinacef (Cefuroxim, Fresenius Kabi AG) and Metronidazol (Metronidazole Bioren, Sintetica SA) were administered for 5 days. The therapy showed to be effective as the patient's condition improved and the cyst volume decreased fast. Over the next months, the recurrent episodes of upper abdominal pain persisted despite a decreased cyst volume. Therefore, a resection of the lesion was planned and a preoperative MRI was performed (Fig. 4), which showed a regression of the tumor in size compared to the initial CT-scan.

A few weeks before the elective surgery, the boy presented to our ER, this time severely in pain with recurrent non-bilious vomiting for 3 days. The patient did not suffer from fever, the abdomen was soft and non-tender. Laboratory values showed no signs of infection. An ultrasound was performed revealing a distended stomach and the known echogenic lesion at the pylorus.

As the lesion appeared to have caused a gastric outlet obstruction, an explorative laparoscopy was performed aimed to remove the obstructing tumor. The procedure was converted to an upper median laparotomy while the lesion was solid and clear margins were not visible (Fig. 5). The complete resection of the lesion included the opening of the pylorus upon which a pyloroplasty was performed. The postoperative course was uneventful and the symptoms resolved entirely during follow-up.

## 3. Results

Histopathological work-up was performed and showed EPT in all three patients (Fig. 6). In the first patient, additional ectopic intestinal tissue was found. There were no signs of malignant transformation in any of the specimens.

## 4. Discussion

In the present paper three cases of symptomatic EPT were described and to the best of our knowledge another 62 cases were found in the literature.


**Fig. 3.** CT-scan of patient 3 (T: Tumor).

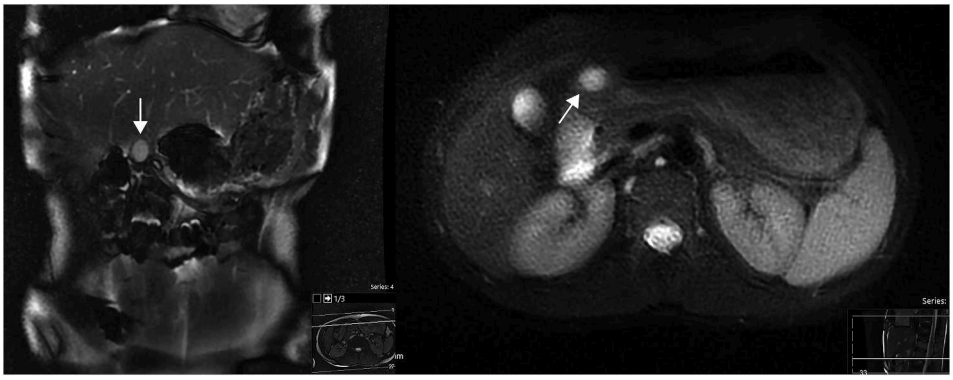

**Fig. 4.** Preoperative MRI of patient 3 (Arrow: Tumor).

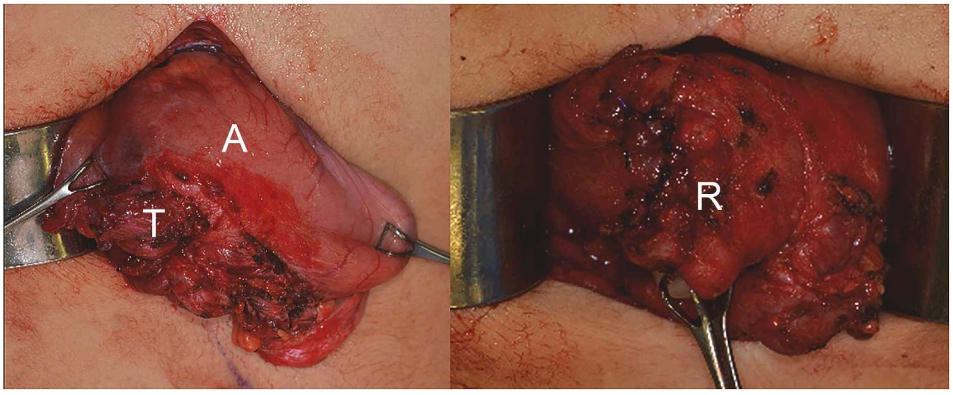


**Fig. 5.** Intraoperative finding in Patient 3 (A: Antrum, T: Tumor, R: Resection margin).

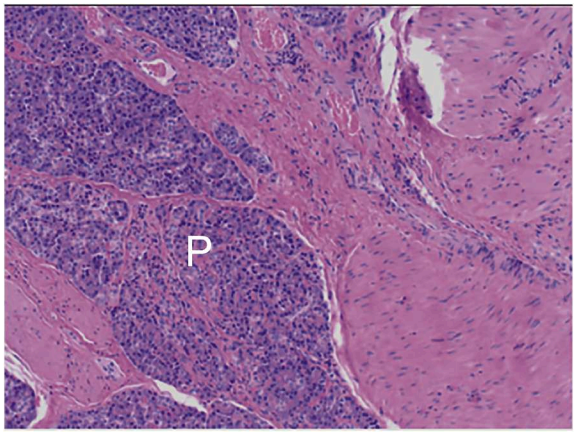


**Fig. 6.** Histopathology of Patient 3 (P: Ectopic pancreatic tissue).

The embryonic etiology of EPT is still not completely understood. Nakame et al. as well as Park et al. proposed three different mechanism how EPT may develop. Their first hypothesis is the misplacement concept, explaining that in embryology during the rotation of the foregut primitive pancreatic tissue can be separated and relocated anywhere in the gastrointestinal tract, where it may develop into mature pancreatic tissue. The second hypothesis is the metaplasia concept, where endodermal tissue migrates to the submucosa of the gastrointestinal tract during embryogenesis and may develop into pancreatic tissue at random sites. The third hypothesis is the totipotent cell concept, arguing that totipotent cells lining the gut may develop into pancreatic tissue by some unknown stimulus [22–25]. EPT in Meckel's diverticulum as well as in vitelline cysts, umbilical fistulas or masses, which are in the literature believed to be remnants of the omphalo-mesenteric duct or yolk sac [26–28], may also develop from totipotent cells.

EPT is often detected incidentally during surgery or at autopsies. The incidence in the literature ranges between 0,5 and 15% [1,2,10,29]. Because of its incidental finding and a very often asymptomatic clinical course, EPT is frequently not diagnosed adequately at first [3]. Although Caberwal et al. reported the first documented case of umbilical EPT already in 1977 [24] and the umbilicus seems to be the second most common location in our literature review [16,18,21–28,30–32], even in our 2 patients the diagnosis came as a surprise. The prevalence of remnants of the omphalo-mesenteric duct is described in literature in 2% of the population, although most of them remain asymptomatic [23]. Tillig et al. described a supraumbilical pseudocystic tumor, which they believed to be caused by chronic inflammation due the secretion of pancreatic enzymes into the space surrounding the EPT in the remnant of the omphalo-mesenteric duct [15].

EPT causing an intestinal obstruction as seen in our third patient, is rare. Goto, Kernohan, Hayes-Jordan and Sharma et al. described patients with EPT at the pylorus, that presented as gastric outlet obstruction with symptoms resembling hypertrophic pyloric stenosis [3,14,33,34]. Our literature review furthermore confirmed that EPT at the gastric antrum or pylorus seems to be the most common site to cause an intestinal obstruction. Younger patients with this finding often presented with vomiting, in some cases also mimicking a hypertrophic pyloric stenosis [35–37]. Older patients, as seen in our third case often suffered from abdominal pain [38]. Kim et al. proposed ultrasound for screening and upper GI contrast study as well as abdominal MRI for further evaluation to be the ideal examination in patients with pyloric masses mimicking hypertrophic pyloric stenosis [35]. Dolan et al. described the macroscopic appearance of intraluminal EPT in the stomach or intestine as usually firm, yellow irregular nodules that are often found in the subserosa or submucosa [5]. In our lit-

**Table 1**
Review of the literature.

| | Author | Publication Date | Sex | Age | Symptoms | Location | Size (mm) | Finding | Surgery |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Kernohan | 1956 | M | 3m | Vomiting, bleeding | Pylorus | – | Necropsy | – |
| 2 | Harris | 1963 | – | Newborn | Umbilical mass | Umbilicus | 4 | – | Tumor excision |
| 3 | Eklof (n = 2) | 1973 | M | 15y | Abdominal pain, vomiting | Antrum | – | – | – |
| 4 | | 1973 | F | 8y | Abdominal pain | Antrum | – | – | Tumor excision |
| 5 | Lucaya | 1976 | F | 3m | Vomiting | Antrum | – | – | Tumor excision |
| 6 | Caberwal | 1977 | M | 13m | Mass, umbilical discharge | Umbilicus | 5–12 | Clinical | Tumor excision |
| 7 | Lalit | 1980 | M | 13y | Umbilical discharge and mass | Umbilicus | – | – | Tumor excision |
| 8 | Chiang | 1982 | M | 1y | Umbilical mass | Umbilicus | – | – | Tumor excision |
| 9 | Mollit (n = 6) | 1984 | M: 4, F: 2 | 6m | Vomiting | Antrum | 5–20 | UGI contrast study & endoscopy | 4 wedge resection, 2 tumor excision |
| 10 | | 1984 | | 8m | Vomiting | Antrum | | | |
| 11 | | 1984 | | 4y | Vomiting | Antrum | | | |
| 12 | | 1984 | | 11y | Abdominal pain | Antrum | | | |
| 13 | | 1984 | | 12y | Abdominal pain | Antrum | | | |
| 14 | | 1984 | | 13y | Abdominal pain | Antrum | | | |
| 15 | Gonzalez | 1988 | F | 9d | Vomiting | Duodenum | 15–29 | Incidental in Surgery | Tumor excision |
| 16 | Visentin | 1991 | M | 18d | Vomiting | Pylorus | – | Ultrasound | Tumor biopsy, watchful waiting |
| 17 | Erdener | 1993 | M | 8m | Intussusception | Ileum | – | Incidental in Surgery | Segment resection |
| 18 | Allison | 1995 | M | 1y5m | Abdominal pain, vomiting | Antrum | – | UGI contrast study | – |
| 19 | Blais | 1995 | M | 22m | Abdominal pain & vomiting | Duplication cyst at the pylorus | 10 | Ultrasound & UGI contrast study | Excision |
| 20 | Avolio (n = 2) | 1998 | M | 8m | Umbilical discharge and mass | Umbilicus | – | Ultrasound | Tumor excision |
| 21 | | 1998 | M | 15m | Umbilical discharge and mass | Umbilicus | 18–21 | Ultrasound | Tumor excision |
| 22 | Hayes-Jordan | 1998 | M | 2d | Vomiting | Antrum | 3–4 | Ultrasound & endoscopy | Tumor excision |
| 23 | Kawashima | 1998 | M | 7d | Vomiting | Noncystic duodenal duplication | – | Ultrasound & UGI contrast study | Excision |
| 24 | Perez-Martinez | 1998 | M | 6m | Umbilical discharge | Umbilicus (Urachus remnant) | – | Clinical | Umbilical exploration and resection |
| 25 | Tan (n = 2) | 1999 | M | 3m | Umbilical discharge | Umbilicus | 10 | Ultrasound, Voiding Cystogram | Tumor excision |
| 26 | | 1999 | M | 2m | Umbilical discharge | Umbilicus | – | – | Tumor excision |
| 27 | Prasad | 2001 | F | 3m | – | Jejunum | 1,5-2 | Incidental in Surgery | Tumor excision |
| 28 | | 2001 | M | 3m | – | Jejunum | – | Incidental in Surgery | Tumor excision |
| 29 | Ozcan | 2002 | M | 1m | Vomiting | Antrum | 4–5 | Incidental in Surgery | Tumor excision |
| 30 | Fragoso | 2003 | M | 21d | Vomiting | Antrum | – | UGI contrast study & endoscopy | Partial gastrectomy |
| 31 | Ormarsson | 2003 | M | 9y | Vomiting | Antrum | 15 | Endoscopy | Tumor excision |
| 32 | Chandan | 2004 | M | 17y | Abdominal pain | Antrum | 10 | Endoscopy | Tumor excision |
| 33 | Sharma | 2004 | M | 1m | Vomiting | Antrum | 5–6 | – | Tumor excision |
| 34 | Tillig | 2004 | M | 2y | Abdominal pain | Supraumbilical | 60–80 | Ultrasound and CT | Tumor excision |
| 35 | Hsu | 2005 | F | 15y | Abdominal pain | Gastric Body | 15 | Endoscopy | Wedge resection |
| 36 | Lee | 2005 | M | 8d | Umbilical mass, discharge | Umbilicus | 7–26 | Clinical & Ultrasound | Umbilical exploration and resection |
| 37 | Matsumoto | 2005 | F | 3y | Recurrent pancreatitis | Mesocolon | 100 | Ultrasound & CAT scan | Extirpation of the mass |
| 38 | Ertem | 2006 | F | 11y | Vomiting | Antrum, Bulbus | 10–15 | Endoscopy | Excision pyloric canal |
| 39 | Ogata (n = 9) | 2007 | M: 3, F: 9 | 1d | – | Jejunum: 3, Stomach: 2, Duoden.: 2, Ileum: 2 | – | Incidental in surgery | – |
| 40 | | | | 16d | – | | – | Incidental in surgery | – |
| 41 | | | | 2d | – | | – | Incidental in surgery | – |
| 42 | | | | 1d | – | | – | Incidental in surgery | – |
| 43 | | | | 1d | – | | – | Incidental in surgery | – |
| 44 | | | | 21d | – | | – | Incidental in surgery | – |
| 45 | | | | 1y | – | | – | Incidental in surgery | – |
| 46 | | | | 3y | – | | – | Incidental in surgery | – |
| 47 | | | | 3y | – | | – | Incidental in surgery | – |
| 48 | Saka | 2008 | M | 6d | Vomiting | Jejunum | 9–10 | UGI contrast study | Wedge resection |
| 49 | De Silva | 2009 | M | 18m | Umbilical discharge | Umbilicus | 10–15 | – | Tumor excision |
| 50 | Tripathy | 2009 | – | 1y | Umbilical mass, asymptomatic | Umbilicus | 20 | Ultrasound | Tumor excision |
| 51 | Goto | 2010 | F | 2y | Abdominal pain | Antrum | 40 | Ultrasound & CT scan | Distal gastrectomy |
| 52 | Singh | 2012 | M | 12y | Intussusception | Ileum | 20–60 | Ultrasound | Segment resection |

(*continued on next page*)

**Table 1** (*continued*)

| | Author | Publication Date | Sex | Age | Symptoms | Location | Size (mm) | Finding | Surgery |
|---|---|---|---|---|---|---|---|---|---|
| 53 | Abdelgabar | 2013 | M | 2y | Recurrent bleeding abrasion | Umbilicus | 3–6 | Ultrasound | Tumor excision |
| 54 | Sharma | 2013 | M | 2y | Umbilical discharge | Umbilicus | 10–12 | Ultrasound | Tumor excision |
| 55 | Kim | 2014 | M | 20d | Vomiting | Pylorus | 4–8 | Ultrasound & UGI contrast study & MRI | Excision |
| 56 | Park | 2014 | F | 3m | Umbilical discharge | Umbilicus | 5–7 | Ultrasound | Tumor excision |
| 57 | Trandafir | 2014 | F | 24d | Vomiting | Jejunum | 10 | Incidental in Surgery | Wedge resection |
| 58 | Jain | 2015 | F | 5y | Abdominal pain | Duplication cyst & accessory pancreatic lobe | – | CAT scan | Excision |
| 59 | Zhao | 2017 | F | 9m | Umbilical discharge | Umbilicus | 20 | Ultrasound | Tumor excision |
| 60 | Juricic | 2018 | M | 15y | Bleeding | Jejunum | 15 | Incidental in Surgery | Wedge resection |
| 61 | Nakame | 2018 | M | 9m | Umbilical discharge | Umbilicus | 3–5 | Clinical & Ultrasound | Umbilical exploration and resection |
| 62 | Seymore | 2018 | F | Prenatal | Hypoglycemia | Abdominopelvic cyst, retroperitoneum | 4–6 | Ultrasound | Excision |

erature review we found two cases depicting EPT located in a duplication cysts, one in a gastric [39] and one in a duodenal location [40]. EPT in the ileum, notably without being associated with Meckel's diverticulum, can function as a lead point for intussusception in children, that may require surgery [41–45].

Overall the finding of EPT in children in other locations than Meckel's diverticulum is quite unusual. Especially, compared to the adult population, pediatric cases are an exception probably due to the paucity of symptoms. A variety of complications may be associated with EPT as bowel obstruction, intussusception, the occurrence of pseudocysts, inflammation, or bleeding (Table 1). Seymore et al. described a case of a newborn with recurrent hypoglycemia due to too high insulin excretion of the EPT [7]. Although malignant transformation is a rare complication in EPT in adults [20], no such case has been described in the pediatric population [4,46]. The treatment of EPT in children is proposed to be the same as in symptomatic Meckel's diverticulum. Therefore complete resection is recommended [4,5,19].

In conclusion, EPT in pediatric patients is a rare finding, with only 65 cases being reported in the literature including our cases. Although the most common location in the antrum of the stomach can cause symptoms like vomiting and abdominal pain, other locations are often detected incidentally.

We consider a full resection of the ectopic tissue necessary to confirm the diagnosis, relieve symptoms and avoid further complications. Especially as seen in our patients, both in the case of an antral gastric mass and in the case of a non-healing umbilical mass despite local treatment, EPT should be considered in the differential diagnosis to initiate proper diagnostics and accurate surgical treatment.

## Patient consent

Although this report does not contain any personal information that could lead to the identification of the patient, we collected the patient's parents written consent for our study.

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## Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

## Declarations of competing interest

None.

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